Recreational Clam Harvest Survey - 1984

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by

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ABSTRACT

Bourne, N., R. A. Carmichael, and B. Bishop-Lowen. 1987. Recreational clam harvest survey - 1984. Can. Tech. Rep. Fish. Aquat. Sci. 1570: 61 p.

Results of a 1984 survey to assess the recreational intertidal clam fishery on ten beaches in southern British Columbia are presented. Time of day appeared to be more important in determining when people dug clams than state of the tide. Most of the catch (82%), was steamer clams, littleneck, Protothaca staminea, and manila, Tapes philoppinarum, which are also important species in the commercial fishery. Some recreational diggers were targetting on these species but much of the catch appeared to result from random digging. There was a tendency for people to dig larger-sized littleneck clams than manila clams. Interviews showed that 72% of the people had catches within the legal recreational limit of 75 clams in total per person per day. One attempt was made to count recreational clam harvesters over an extended area from an aircraft and methods are described to improve this assessment technique.

Key words: recreational clam fishery, British Columbia, Canada

RÉSUMÉ

Bourne, N., R. A. Carmichael, and B. Bishop-Lowen. 1987. Recreational clam harvest survey - 1984. Can. Tech. Rep. Fish. Aquat. Sci. 1570: 61 p.

On présente les résultats d'une enquête effectuée en 1984 sur la pêche sportive des clams dans la zone intertidale de dix plages situées au sud de la Colombie-Britannique. Il semble que l'heure ait une plus grande incidence que le niveau de la marée sur le moment où la pêche s'effectue. Les "steamers", soit la quahaug commune (Protothaca staminea) et l'asari (Tapes philippinarum), constituaient la plus grande partie des prises (82 %); ces espèces font aussi l'objet d'une exploitation commerciale. Certains pêcheurs sportifs recherchaient exclusivement ces espèces mais la plus grande partie des prises était le résultat d'une pêche aléatoire. Les grosses palourdes étaient plus fréquentes dans les prises que les gros asaris. Les résultats d'entrevues ont révélé que 72 % des pêcheurs étaient en possession d'un nombre de clams qui se situait dans les limites légales de la pêche sportive de 75 clams par personne par jour. On a tenté à une occasion de dénombrer à partir d'un aéronef les pêcheurs sportifs de clams présents sur une grande superficie. On décrit des méthodes permettant d'améliorer cette technique d'évaluation.

Mots-clés: pêche sportive des clams, Colombie-Britannique, Canada

INTRODUCTION

Invertebrate resources in British Columbia support small but important commercial fisheries that are important to many coastal communities (Quayle and Bourne 1982; Bernard 1982; Jamieson and Francis 1986; Noakes and Jamieson 1986). Species harvested and catch are reported annually and there have been numerous studies to provide information to formulate management policies for these fisheries (Quayle and Bourne 1972; Jamieson 1984, 1985).

Invertebrate resources are also widely used in the recreational or sports fishery but this fishery has been largely ignored and there is little information on it. The belief has been that it is a minor fishery and catches are insignificant when compared to total invertebrate landings in commercial fisheries. However, there is general agreement within the Department of Fisheries and Oceans that recently there has been a significant increase in the recreational harvest of some invertebrates and studies are needed to determine the size and importance of this fishery. Species caught, size of catch and amount of effort expended are virtually unknown but the recreational catch could be significant in some areas. A 1980 study in statistical area 29 estimated that 31,000 (20 t), Dungeness crabs, Cancer magister, were caught in the recreational fishery which is approximately 17% of the commercial catch in the same area (Ketchen et al. 1983). Further examples of the significance of recreational invertebrate fisheries are seen in studies from the west coast of the United States (Williams 1975, 1979; Schink et al. 1983). Instances of heavy recreational exploitation of British Columbia invertebrate resources are probably not isolated and indicate the need for close study and monitoring of this fishery.

The recreational invertebrate fishery in British Columbia will undoubtedly continue to expand as human populations increase and people have more leisure time. Conflicts already exist between recreational and commercial fisheries and these will probably continue to increase. Meaningful management policies can only be formulated if the extent and impact of recreational fisheries on stocks are known. Although there are programs to assess recreational finfish fisheries (Bijsterveld 1983; Shardlow 1983) they are not designed to collect information on invertebrates. In most situations it is probably not practical to adapt finfish sampling programs to include information on recreational invertebrate fisheries; programs must be designed specifically to obtain this information. A project in 1983 developed methods to sample recreational invertebrate fisheries in British Columbia (Carmichael and Bourne 1986).

In 1984 a project was undertaken to begin initial sampling of the recreational invertebrate fishery in British Columbia. Because of time and funding constraints it was decided to confine the project to an assessment of the recreational harvest of intertidal clams on selected beaches along the southeast coast of Vancouver Island, an important clam harvesting area (Quayle and Bourne 1972). This decision was based on the fact that intertidal clams are probably the most widely harvested species in recreational invertebrate fisheries in the area.

The 1984 survey had two main objectives. The first was to test sampling methods proposed by Carmichael and Bourne (1986) and assess their effectiveness in sampling recreational clam fisheries; the second was to obtain initial data on this fishery.

BEACHES SAMPLED

The southeast coast of Vancouver Island (statistical areas 14, 17 and 18) is an important clam harvesting area (Quayle and Bourne 1972). There are numerous beaches of varying size, many with easy road access, that have supported commercial clam harvesting operations for many years and observations by fisheries personnel indicate many are widely used by recreational diggers. Because of time and personnel constraints it was not possible to sample all or even a major portion of beaches in the area so sampling was confined to ten beaches that reportedly had extensive recreational use. The beaches were distributed from Williams Beach in the north to Bamberton in the south (Fig. 1). All beaches are readily accessible by road.

Beaches were divided into four areas.

Comox Area

In the north four beaches were sampled; Bates Beach, Kye Bay, Williams Beach and Willemar Bluff and they are referred to as the Comox Area (Fig. 1). These four beaches are close to Courtenay and Comox and are used by residents of these two communities as well as by tourists in the area.

Nanaimo Area

Two beaches were sampled in the central part of the area, Parksville and Cedar Shore and are referred to as the Nanaimo Area (Fig. 1). The beach at Parksville is used to some extent by local residents but more extensively by tourists to the area. Cedar Shore beach is used mostly by local residents.

Nanoose

The beach at Nanoose is within the Nanaimo Area but in this survey it was considered as a separate beach and is referred to simply as Nanoose (Fig. 1). This is a large beach, close to the Pacific Biological Station and is adjacent and clearly visible from the main island highway. It is used extensively by both commercial and recreational clam harvesters. This beach was sampled intensively to provide as much detailed information as possible on recreational clam harvesting in order to provide baseline data for this and future recreational clam harvesting surveys. Part of this beach has been designated as a Provincial Recreational Shellfish Reserve.

Victoria Area

Three beaches were sampled in the southern part of Vancouver Island; Pat Bay, Mill Bay and Bamberton and are referred to as the Victoria Area (Fig. 1). Pat Bay is frequently used by recreational clam harversters from Victoria. The beach at Mill Bay is used by people from Duncan. The beach at Bamberton abuts a Provincial Park and campsite and is used by tourists to the area as well as locals from Duncan and Victoria.

In addition to these 10 beaches, cursory observations and sampling were made at some beaches in the Gulf Islands region, another important commercial and recreational clam harvesting area (Quayle and Bourne 1972).

SAMPLING PROCEDURES

Sampling was carried out during four low tide cycles in August and September 1984, and confined to periods when low tide was 1.9 m or less above the low water mark (as recorded at Point Atkinson and Fulford Harbour). This procedure insured that sampling was undertaken on both weekdays and weekends. Samplers arrived at beaches approximately 2.5 hours before low tide and remained there for a similar period afterwards. The beach at Nanoose was sampled daily during the four low tide periods. Beaches in the Courtenay-Comox area were only sampled during the first tidal cycle in August. Beaches in the Nanaimo and Victoria areas were sampled during the last three tidal cycles. Beaches at the head of Finlayson Arm, along the Trincomali Channel side of Saltspring Island and on Thetis Island were visited on one occasion each during the survey but no recreational harvesters were observed and sampling was not continued further at these locations.

Carmichael and Bourne (1986) suggested information on the recreational fishery should be collected in five categories to provide an assessment of the impact of this fishery on invertebrate stocks and this was followed in the 1984 survey. The five categories are:

1. Temporal distribution of recreational harvesters: - at what time of day and at what state of the tide do recreational harvesters dig clams.

2. Spatial distribution of recreational harvesters: - where do recreational harvesters dig clams most frequently on intertidal beaches.

3. Harvester profile: - what are the digging characteristics and knowledge of recreational clam harvesters.

4. Catch: - species, amount, and size frequency distribution of clams dug by recreational harvesters.

5. Overflights: - use of observations from aircraft to estimate numbers of recreational clam harvesters over extended areas.

Temporal Distribution of Recreational Harvesters

Beach use over time was recorded by observing numbers of groups and individuals digging on beaches at half hour intervals, beginning two hours before low tide and finishing about 2.5 hours after low tide. At beaches with a single access point samplers could wait there and count and interview diggers as they entered or left the beach. Most beaches had more than one access and samplers walked along the beach to obtain the information.

Spatial Distribution of Recreational Harvesters

Location where recreational diggers concentrated on beaches was obtained by samplers walking along beaches and periodically recording the position of diggers on beaches.

Harvester Profile

Recreational clam diggers were interviewed on beaches or as they left to establish a harvester profile based on digging characteristics and related shellfish knowledge. This also provided an opportunity for samplers to estimate daily and yearly catches by recreational harvesters.

Daily weather observations were also recorded to determine if weather affected harvesting patterns of recreational diggers.

Catch

Catch data were recorded by sorting the catch into species and counting the number of each species. When time permitted, and recreational harvesters were willing, shell length of all or a portion of the catch was measured with calipers to the nearest mm to provide data on size distribution of clams in catches. In addition, samplers estimated catch by species when actual counts were not possible.

Overflights

Carmichael and Bourne (1986) stated that a practical method to determine numbers of recreational diggers over extended areas was to make observations from aircraft. This method is used regularly in the State of Washington to estimate numbers of recreational clam harvesters there (A. Scholtz, pers. comm.). A ratio of recreational to commercial clam diggers can be established if flights are made over beaches where ground samplers are interviewing diggers, thus enabling a more accurate estimate of the number of recreational diggers.

One flight was made on Sunday August 26, 1984, low tide 1150 (PDT at Point Atkinson). The weekend and late morning tide provided good conditions for maximum numbers of recreational harvesters on beaches. The weather was

overcast and cool with a modest southwest wind. The flight left Nanaimo at 1030 and flew north along the east coast of Vancouver Island to just north of Williams Beach, across the Strait of Georgia to Savary Island and back to Nanaimo. The flight continued south along the east side of Vancouver Island to Finlayson Arm, across to Pat Bay, over to Saltspring Island and along Trincomali Channel to Nanaimo. The aircraft flew from 100 to 200 m off beaches at a height of about 100 m and at a speed of approximately 90 knots.

Two observers went on the northern portion of the flight each independently counting clam diggers. This provided an opportunity to compare data between the two observers. Only one observer went on the southern part of the flight.

RESULTS

Sampling was done over 25 days during four low tide cycles in August and September on 10 beaches from Pat Bay in the south to Williams Beach in the north (Fig. 1) (Table 1). At Nanoose sampling was done on 24 of 25 sampling days and this routine produced the greatest amount of data; 70% of the total number of groups and 76% of the total number individuals were from this area. Sampling was done on four days in the Comox area and on 11 days in both the Nanaimo and Victoria areas. A total of 286 groups, representing 917 individuals, were counted (Table 1).

Most recreational harvesters dug clams in groups of two or more; as couples, families or groups of friends. This caused a problem in recording information. Generally one person in a group talked to the sampler and replied to questions and hence answers reflected the activities of that one individual or those of the group. Hence, most of the information collected in the survey is reported as group responses rather than responses of individuals.

Temporal Distribution of Recreational Harvesters

Most recreational harvesters did not arrive on beaches before 1000 h. When mean number of harvesters was plotted in half hour intervals against state of the tide it showed most recreational harvesters didn't arrive on beaches until approximately half an hour before low tide but many were still there two hours after low tide (Fig. 2). This harvest pattern can affect species of clam harvested since areas of major concentrations of butter (Saxidomus giganteus) and littleneck (Protothaca stamined) clams would be largely covered by water 1.5 hours after low tide and diggers would be harvesting in areas where manila clams (Tapes philippinarum) are the dominant species.

Higher numbers of recreational harvesters were counted on beaches on weekends than during the week, fewest numbers of diggers were observed on Mondays and Fridays (Fig. 3). This probably reflects a higher number of local people digging on weekends than during the week.

Poor weather did not appear to affect numbers of recreational diggers on beaches (Fig. 4). In fact more people were counted on beaches during days with poor weather than on days with better weather.

Spatial Distribution of Recreational Harvesters

Most recreational harvesters tended to dig near other people who were digging clams. Presumably they assumed that other people knew where clams were abundant and joined them. A few groups preferred to dig at a distance from other people. These may have been people who felt they knew where areas of dense clam concentrations were located or locals who had a favourite place to dig clams.

Harvesting patterns varied from group to group. Most groups concentrated in one particular area until they had their catch while others changed digging sites more than once during the outing.

Most recreational harvesters did not appear to do any test digging or look for siphon holes to locate areas of dense clam concentration. Recreational harvesters did not appear to select areas with particular reference to tidal height on intertidal beaches. Some diggers appeared to walk the minimum distance from their vehicle to the beach and then started to dig clams.

Harvester Profile

Information on digging characteristics and knowledge of recreational harvesters was obtained from interviews and recorded on a form (Appendix 1) that was revised early in the survey to provide more detailed information (Appendix 2).

Most harvesters interviewed (63%) were local residents residing on Vancouver Island or in the lower mainland (Table 2). Only in the Nanaimo area did non-residents outnumber local diggers (62% compared to 38%). This probably reflects a large tourist population in the Parksville area.

Digging frequency of recreational harvesters differed between resident and non-resident diggers. Resident diggers reported making an average of 5.7 trips per year to harvest clams, non-resident diggers 2.5 times per year (Table 3). On the average recreational harvesters reported they made 1.3 trips per tidal series (Table 4). In the present survey, only 9% of people interviewed (all residents) dug clams on night tides during the fall and winter (Table 5).

Most recreational harvesters (49%) generally dig on only one beach (Table 6). In the Victoria area 69% and in the Comox area 64% of people said they only dug on one beach. Even those that said they dug on more than one beach reported they only do so in a restricted area. Only 4% of people interviewed at Nanoose said they dug on beaches outside the Nanaimo area.

The commercial clam fishery is regulated by a size limit; no littleneck or manila clams can be harvested that measure less than 38 mm shell length and no butter clams can be harvested less than 63 mm shell length. There is no size regulation in the recreational fishery. The recreational clam fishery is regulated by a daily catch limit. South of Cape Caution (except within the boundaries of Pacific Rim National Park), recreational harvesters are limited to an aggregate of 75 clams per person per day of which 12 may be razor clams and 25 may be butter clams. North of Cape Caution, recreational harvesters may dig an aggregate of 75 clams per person per day.

In three areas, Nanoose, Nanaimo and Victoria, less than half the people interviewed were familiar with recreational shellfish harvest regulations but in the Comox area 73% said they knew them (Table 7). However, 63-73% of the people interviewed said they were aware of PSP (paralytic shellfish poisoning) and sewage pollution closures (Table 7).

Answers to another question showed that 41-54% of people interviewed had a salmon sports fishing license (Table 8).

Catch

Information on catches of recreational clam harvesters was obtained in three ways; direct measurement of catches by samplers, estimates of catches by samplers, and from answers to questions during interviews.

Part or all of the catch of 96 groups (34% of the total group interviewed) was sampled to determine amount, species and size distribution of harvested clams (Table 9). Samples ranged from 21% of groups in the Victoria area to 64% in the Comox area.

Main species harvested in all areas were littleneck and manila clams (steamer clams) which accounted for 82% of catches sampled (Table 10). Butter clams comprised 14% of catches sampled. Cockles (*Clinocardium nutalli*), sand clams, *Macoma* sp., horse clams (*Tresus capax*), and soft-shell clams (*Mya arenaria*) were of minor importance. The proportion of manila clams in catches may have been higher than recorded because of sampling problems. Measurements could only be done as time permitted and the large number of diggers at Nanoose sometimes made measurement of catches impossible. Observations by samplers indicated people dug a higher proportion of manila clams on this beach than any other species.

Estimates made by samplers of species composition of some catches that could not be measured showed a preponderance of steamer clams (Table 11). Manila clams formed the highest percentage of clams in catches at Nanoose but littlenecks were highest in the Nanaimo and Victoria areas.

When asked if they targetted on a particular species about 32% of people interviewed said they were not targetting on any particular species but were simply digging clams (Table 12). Of those people targetting on particular species, 28% targetted on steamer clams. Other diggers were targetting on a combination of steamer and butter clams or other species of clams. Data in Table 12 may be slightly inaccurate because many people were not able to distinguish species of clams.

Size frequency distribution of clams sampled is shown in Figures 5-11. Pooled results show that 80% of littleneck clams were 38 mm shell length or larger, the legal size in the commercial fishery, but only 57% of manila clams were above this size. Recreational diggers were harvesting smaller manila clams than littleneck clams. With butter clams, 51% were 63 mm shell length or larger, the legal size in the commercial fishery.

When size frequency distribution is broken down into the four areas results from Nanoose and Nanaimo areas are similar to the pooled data (Figs. 8, 9), but this is due mainly to the fact that most samples came from these two areas. Most littleneck clams were larger than 38 mm shell length, about half the manila clams were above this size and less than 50% of butter clams were larger than 63 mm. In the Victoria and Comox areas there was a tendency to harvest larger clams than in the Nanoose and Nanaimo areas (Figs. 8-11).

Counts of number of clams per individual showed that approximately 72% of people had catches within the legal recreational limit, 75 clams in total per person per day (Table 13). However, 16% of people had over 100 clams per person and six individuals had over 400 clams per person.

Overflight

There was general agreement in counts of clam diggers by the two aircraft observers however, in some instances one observer considered groups were commercial diggers while the other thought they were recreational harvesters (Table 14). At the time it was difficult to count individual numbers of diggers and some groups were missed by either observer because too much attention was spent trying to distinguish between commercial and recreational diggers.

Digging was observed on many more beaches than were visited by ground samplers during the survey period.

Two beaches, Nanoose and Mill Bay, were sampled by ground samplers on the same day as the flight and this allowed for a comparison of counts of recreational diggers by the two sampling methods. Sample size is limited but there was general agreement between the two sampling methods.

DISCUSSION

Temporal and Spatial Information

Time of day appeared to be more important than state of the tide in determining number of recreational clam diggers on beaches. Some local residents may have knowledge of tides but many appear to make plans to dig clams at a particular time and go out at that time regardless of the state of the tide. Many tourists have little knowledge of tides. Frequently they see people on beaches, enquire what they are doing and begin to dig clams themselves.

Better use of sampling personnel could be made if sampling was confined to periods of heavy beach use by recreational harvesters. Few recreational diggers appeared on beaches before 1000 h. If low tides were early in the morning few people took advantage of them. Our results showed that if samplers go out an hour before low water and remain there for two hours afterwards they would interview most recreational harvesters. However, some sampling should continue for as long as three to four hours after low water to see how long recreational diggers remain on beaches digging clams since manila clams can occur in modest numbers well above the mid intertidal beach level (Quayle and Bourne 1972). Sampling should also be extended to include tides as high as 2.5 m. Some recreational diggers, particularly those in tourist facilities with easy beach access, may find it rewarding to harvest these manila clam populations high up on intertidal beaches.

Poor weather apparently has little effect on the number of people digging clams. This may be due partly to the fact that people make plans to go clam digging and go regardless of the weather. Another explanation may be that on days with poor weather, particularly if it is windy, recreational fishermen are unable to go sports fishing and decide instead to go to the beach and dig clams.

The survey should be greatly expanded both spatially and in time of year to determine the extent of the recreational fishery on clam stocks in British Columbia. Beaches in other areas (e.g. Barkley Sound, top end of the Strait of Georgia, Desolation Sound) have heavy recreational clam digging. The present survey was done in August and September but more extensive recreational digging probably occurs earlier in the year. From October to the end of February low tides occur at night. In the present survey 9% of people interviewed reported they had dug on night tides (Table 5). The recreational harvest of clams on night tides is probable minimal but it should be determined. With the first daylight low tides in March there is generally considerable recreational clam digging mostly by local residents. In June and July there is an increase in numbers of recreational diggers on beaches because of the influx of tourists. Harvesting trends of recreational diggers over an extended area and throughout (Bourne, unpublish MS) the period of daylight tides should be determined.

No definte spatial distribution pattern of recreational harvesters was observed on any beaches. Although some diggers could distinguish between clam species virtually no one was aware of the best types of clam habitat and hence where to dig. A few people appeared to go to specific locations but these were probably local residents returning to favourite locations. Most people went to where other prople were digging, often commercial diggers, and began digging. Recreational harvesters did not appear to concentrate their efforts at any particular tidal height on intertidal beaches and this would effect species of clam harvested.

A proposed data sheet that can be computer coded for recording temporal distribution of clam diggers is shown in Appendix 3.

Harvester Profile

Considerable information was obtained from interviewing recreational harvesters and additional information could be obtained with an improved questionaire.

Wording in the questionaire was found to be important. Digger responses varied with question wording. An example was the change in wording from, "Are you a coastal resident" to "Are you a local resident"? Many people interpreted the wording, "coastal resident", to mean living on the waterfront rather than living in the coastal area. Few recreational diggers understood the meaning of tidal cycle and to get an idea of digging frequency it was better to ask how many times they dug in a week rather than how many times they dug during a tidal cycle.

It is essential that samplers be thoroughly trained in order to obtain reliable data. Samplers must be able to identify clam species and have training in interview techniques. It was found samplers had best results when they rehearsed their approach to recreational clam harvesters, stressed the reason for the survey, used the word research, and gave some explanation of how the survey would assist with future management of clam resources. It was also found to be advantageous to have one person sample the same beach for a tidal series. The sampler became familiar with repeat diggers and could save time and avoid excessive officialdom by trying to question the same group more than once.

Samplers were often asked to answer questions from recreational harvesters such as; what is the difference between species of clams, what are the regulations, and where are clams abundant. This was good for public relations and probably aided in obtaining more accurate data from recreational diggers. Samplers had copies of the Sports Fishing Guide and left them with groups if they wished them. In future having other types of hand-outs, e.g. the clam fact sheet, would be advisable.

These questions indicated that many recreational harvesters had little knowledge about clams or where to dig them. In some instances it appreared that families had decided to spend some time on the beach as part of their recreational activity and to make the trip more profitable had decided to dig some clams.

In future it would be advisable if such a survey program were well advertised in the media so that people would be aware of it. Most people interviewed were cooperative and indeed only one group refused to answer questions. However, it was felt that many people wondered why they were being questioned, particularly when asked if they knew the recreational harvest regulations.

The questionaire produced a volume of information that took much time to analyse. A questionaire for future surveys is proposed that would allow answers to be coded for computer use and this would greatly enhance analysis of the data (Appendix 4). Other forms for recording data are suggested in Appendices 5-7.

A problem encountered was that often when a group was interviewed a single person answered for the group. If the group was a couple or a family this probably was a good reflection of the digging activities for all members of the group. However, in some cases the answer reported the digging habits of that single person rather than others in the group. The proposed questionaire allows for individual responses to certain questions and these differences can be identified.

It was of interest that more people knew about shellfish closures because of PSP or pollution than knew about the daily harvest limit regulations. Virtually no one, recreational or commercial digger, knew about the Recreational Shellfish Reserve at Nanoose. Continued efforts are needed to educate the public about the recreational clam fishery so that daily bag limits are observed and people do not harvest in closed areas.

The Carmichael and Bourne (1986) report suggested that if funds or personnel were limited some information on recreational shellfish harvesting might be obtained by plugging into existing sports fishing surveys. Results of the survey show that only about 50% of recreational clam diggers would be covered through such an approach. A survey specifically designed to collect information on invertebrate recreational fisheries is needed to obtain more complete information of the fisheries.

Catch

Actual counts and estimates by samplers showed most of the catch of recreational harvesters was steamer clams, littleneck and manila clams. Many people reported they were targetting on these two species and undoubtedly were and prefer them (Table 12). However, many people could not distinguish between clam species and were digging randomly. The high proportion of these species in catches was due to other reasons. On most beaches littleneck and manila clams were the dominant harvestable clam species and these species would appear most frequently in catches from random digging. Many recreational harvesters dig in association with other diggers, some of whom were commercial diggers, particularly at Nanoose. The commercial fishery was targetting on steamer clams, particularly manila clams, and recreational diggers associating with them would naturally harvest more steamer clams than other species. People digging later in the tidal cycle would be in areas where littleneck and manila clams are more abundant and these species would

appear more frequently in their catches. Another explanation for the dominance of steamer clams in catches of recreational diggers is that these two species occur at shallower depths in the substrate and are easier to dig than butter or horse clams. Many recreational diggers were poorly equipped to dig clams and steamer clams could be readily dug with rakes, shovels and children's beach toys.

Answers given to samplers concerning target species can also be misleading. Many people who can distinguish clam species refer to steamer clam as butter clams since they are usually eaten steamed and then dipped in drawn butter. Most recreational diggers could not distinguish clam species and when samplers identified species for them, recreational diggers simply said they were targeting on them; in essence they were targeting on whatever species was dominant in their catches. Another problem was that some recreational diggers responded in the way they thought would support the question or they gave an answer that they were actually digging randomly. These problems can be avoided to some extent with better question wording and more training of samplers in interview techniques.

Recreational harvesters were rather indiscriminate in size of clam selected. Few clams smaller than 30 mm shell length were kept. More small manila clams were kept than littleneck clams but this may reflect easier availability of manila clams. The larger number of small clams in catches at Nanoose was probably due to a higher number of diggers sampled there, many of whom were tourists and unfamiliar with clam digging.

An attempt was made to estimate number of clams harvested per year by recreational diggers (Table 15). Mean number of clams per recreational harvester was determined from catch counts and number of trips per year was obtained from the questionaire. The estimate is approximate but indicates considerable quantities of clams can be removed from beaches by recreational harvesters in a year.

Overflight

Slight discrepancies in counts of clam diggers occurred between the two observers on the northern part of the flight (Table 14). On this part of the flight one observer sat in the co-pilots seat and the other on a seat behind the pilot and other observer. The person in the back seat had access to windows on each side of the aircraft. The person in the co-pilots seat had a slightly obstructed view since the pilot was between him and the beach. At times it was difficult for that observer to see the beach and some diggers were probably missed. In future if an observer is to occupy the co-pilots seat the flight plan should be laid out so he/she is immediately adjacent to the beach and has an unobstructed view of the beach.

There was close agreement between counts of diggers by aircraft observers and ground samplers. Slightly higher counts by aircraft observers were due to them observing larger areas than covered by ground samplers.

The major probem encountered by aircraft observers was that the airplane travelled so quickly it was difficult to observe and count diggers and record data by writing it down in log books. Some diggers were missed while recording data. This problem could be corrected by adopting two techniques. The flight plan should be thoroughly reviewed prior to take off and beaches to be observed should be high-lighted on a chart and coded with a numbering system. Observers would know what beaches they were approaching and would not miss diggers by trying to identify the beach on a chart. The second technique that should be adopted is that data should be recorded on a tape recorder. In this way observers would not have to take their eyes off beaches while recording information and could make accurate counts of diggers.

Some difficulty was experienced distinguishing between commercial and recreational clam diggers. However, with practise it should be possible to distinguish between these two groups of diggers because of equipment used by commercial diggers.

With practise it should be possible to develop a standard technique that would enable aircraft observers to make accurate counts of commercial and recreational clam diggers over extended areas.

Future Developments

A better technique is needed to measure clams. Use of calipers provides accurate measurements but it is too time consuming, particularly if there is only one sampler on a beach with many clam diggers. Most people interviewed were cooperative but recreational diggers do not want to wait for ten or fifteen minutes while their catch is measured, particularly if they are leaving the beach. They want to get in their vehicles and get on their way. The Carmichael and Bourne (1986) report suggests other methods to measure clam size and they should be tried.

A detailed study might be undertaken to determine the combined effects of recreational and commercial fisheries on clam populations. This could be done through intensive sampling at one beach, e.g. Nanoose. Before the survey began an intensive biological sampling program could be undertaken to assess intertidal clam populations. This would provide information on location of clam populations on the beach (beds), population size, and size frequency distribution of clams in beds. Sampling of both commercial and recreational clam harvesters could be done regularly and a model could be constructed to show the effect both fisheries have on clam populations on that beach. This model might then be applied to other beaches where recreational clam digging occurs in the Province.

ACKNOWLEDGMENTS

Sincere appreciation is extended to those people who participated in the sampling program and to the pilot of the aircraft who did everything possible to make the flight a success. We thank Dr. L. Richards and T. Gjernes for reviewing the manuscript.

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Table 1. Number of groups and individual recreational clam harvesters observed at ten beaches in the Strait of Georgia during the recreational clam harvest survey, August-September 1984. Top figure is number of groups; bottom figure number of individuals.

	August							August									September					September				
	8	9	10	11	12	13	14	22	23	24	25	26	27	28	29	30	7	8	9	10	11	21	22	23	24	Total
1. Nanoose	4	9	6	21	14	1	7	10	10	6	11	24	11	7	10	4	2	4	9	3		5	8	9	3	198
	12	34	26	63	60	3	21	38	32	25	31	89	46	30	31	21	5	8	28	11		7	25	41	13	700
2. Cedar Shore								1	1	1	1															4
3. Parksville								1	1	1	1															4
														1			1		3	5		1	3	2		16
4. Bamberton														6			2		8	16		3	16	4		45
										2	4	3					2	2	10		4		2	6	5	40
5. Mill Bay										3	12	11					3	4	27		8		6	11	13	98
										2	4	5									1		2			14
6. Pat Bay										4	9	10									2		5			30
								1			2															3
								3			3															6
7. Bates Beach		2																								2
		9																								9
8. Kye Bay	2	1	1																							4
	4	2	3																							9
9. Williams	2																									2
	2																									2
10. Wilmar Bluff		1	1			1																				3
		5	4			5																				14
Total																										286
																										917

Table 2. Number of resident and non-resident recreational clam diggers interviewed during the recreational clam harvest survey, August-September 1984.

Area	Number of resident diggers	Number of non-resident diggers
Nanoose	396	262
Nanaimo	16	26
Victoria	99	12
Comox	16	13
Total	527	313

Table 3. Mean number of clam trips per year as reported by groups of recreational clam diggers interviewed during the recreational clam harvest survey, August-September 1984.

Area	Number of harvester groups interviewed	Mean number of digs per year	Mean number of digs per year for resident diggers	Mean number digs per year for non-resident diggers
Nanoose	186	4.2	5.3	2.3
Nanaimo	17	5.4	8.5	1.9
Victoria	51	5.0	5.2	3.7
Comox	11	7.5	10.9	1.5
Total	265	4.6	5.7	2.5

Table 4. Mean number of digs per tidal cycle as reported by groups of recreational clam diggers interviewed during the recreational clam harvest survey, August-September 1984.

Area	Number of harvester groups interviewed	Mean number of digs per tidal series
Nanoose	186	1.3
Nanaimo	17	1.6
Voctoria	51	1.2
Comox	11	1.1
Total	265	1.3

Table 5. Number of recreational harvester groups that reported digging clams on night tides as recorded during the recreational clam harvest survey, August-September 1984.

Area	Number of harvester groups interviewed	Number of groups that reported digging on night tides
Nanoose	186	13
Nanaimo	17	3
Voctoria	51	5
Comox	11	2
Total	265	23

Table 6. Beaches used by recreational clam harvesters as reported by harvester groups during the recreational clam harvest survey, August-September 1984.

Area where recreational clam harvesters surveyed	Other Beaches Reported Used				
	No other beaches	Nanaimo beaches	Victoria beaches	Comox beaches	Other beaches
Nanoose	80	98	6	2	0
Nanaimo	8	2	5	1	1
Victoria	35	1	9	1	5
Comox	7	1	0	3	0
Total	130	102	20	7	6

Table 7. Number of recreational clam harvester groups interviewed during the August-September 1984 recreational clam harvest survey who were aware of the regulations and who were aware of clam closure areas.

Area	Harvester groups interviewed	Number who knew recreational harvest regulations	Number who knew PSP and contaminated clam area closures
Nanoose	198	85	125
Nanaimo	17	8	11
Victoria	51	22	37
Comox	11	8	8

Table 8. Number of recreational clam harvester groups interviewed during the August-September 1984 recreational clam harvest survey who had a tidal-water sports fishing license.

Area	Number interviewed	Number with salmon sports fishing license
Nanoone	198	107
Nanaimo	17	7
Victoria	51	24
Comox	11	6
Total	277	144

Table 9. Number of recreational clam digging groups from which clams were measured in the recreational clam harvest survey, August-September, 1984.

Area	Number of groups interviewed	Number of groups from which clams were measured
Nanoose	198	66
Nanaimo	20	11
Victoria	57	12
Comox	11	7

Table 10. Number of each species of clam measured in samples taken from catches of recreational clam diggers in the recreational clam harvest survey, August-September 1984.

Species	Scientific name	Number measured
Littleneck	Protothaca staminea	2250
Manila	Tapes philippinarum	1625
Butter	Saxidomus giganteus	643
Cockle	Clinocardium nuttalli	87
Sand	Macoma sp.	69
Horse	Tresus capax	54
Soft-shell	Mya arenaria	6
Other		3

Table 11. Estimate of species composition of clam catches of recreational diggers in the recreational clam harvest survey, August-September, 1984.

Area	Number of groups interviewed	Number of groups in which catch estimated	Estimated number of clam species in catch			
			Little-neck	Manila	Butter	Other
Nanoose	198	66	4614	5485	970	48
Voctoria	20	12	1033	27	427	57
Voctoria	57	34	2524	1477	597	207
Comox	11	0				
Total	286	112	8171	6989	1994	312

Table 12. Target species of recreational clam harvesters as reported to interviewers during the recreational clam harvest survey, August-September, 1984. Values in number of groups responses.

Area	Groups answering questions	No target species	Steamer clams	Steamer and butter clams	Steamer and other species	Butter clams	Butter clams and others	Steamer, Butter and others	Others
Nanoose	141	36	47	15	18	9	3	7	6
Nanaimo	15	3	2	9	0	1	0	0	0
Voctoria	48	28	10	5	2	0	2	0	1
Comox	11	2	2	4	0	1	0	0	2
Total	215	69	61	33	20	11	5	7	9

Table 13. Number of clams harvested per individual as recorded during the recreational clam harvest survey, August-September, 1984.

Area	0-75	75-100	101-150	151-200	201-250	251-300	301-350	351-400	401-450
Nanoose	373	57	36	18	9	6	2	0	6
Nanaimo	34	4	3	2	0	0	0	0	0
Voctoria	74	19	9	10	0	5	0	0	0
Comox	0	1	0	0	0	0	0	0	0

Table 14. Number of clam diggers recorded on beaches by observers in aircraft and by beach samplers on August 26, 1984, during the 1984 recreational clam harvest survey.

Beach location	Time	Number of clam diggers		
		Aircraft observers		
		Observer 1	Observer 2	Beach samplers
Nanoose	1045	4-5 groups (commercial)	1 group	
Rathtrevor	1055	0	1 group	
Parksville	1056	6 groups	7 groups	
French Creek	1057	2 groups	1 group	
Qualicum	1059	1 group	0	
Little Qualicum	1101	1 group	2 groups	
Big Qualicum	1105	1 group	1 group (5 individuals)	
Qualicum Bay	1106	0	2 groups	
Deep Bay	1107	2 groups	3 groups (5,2,1 individuals)	
Buckley Bay	1112	4 groups (commercial)	5 groups (4 commercial, 1 recreational)	
Union Bay	1113	2 groups (1 recreational)	2 groups (4 and 4 individuals)	
North Tip Denman Island	115	1 group	1 group	
Seal Island	1117	4 groups (probably commercial)	4 groups (2 may be recreational)	
Cape Lazo	1122	0	0	
Kye Bay	1124	3 groups	3 groups (2,2,4 individuals)	
Little River	1125	4 groups	6 groups (2 individuals per group)	
Bates Beach	1127	1 group	0	
Williams Beach	1129	2 groups	2 groups (3,2 individuals)	
Savary Island	1135	3 groups	3 groups (2,4,3 individuals)	
Parksville	1209	1 group	1 group (4 groups leaving beach)	
Nanoose	1217	11 groups (commercial)	11 groups (commercial 17 individuals)	8 groups (5 commercial, 3 recreational)
Lantzville	1218	5 groups (commercial)	5 groups	
Cedar Shore	1239	0		
Yellow Point	1241	1 group (2 individuals)		

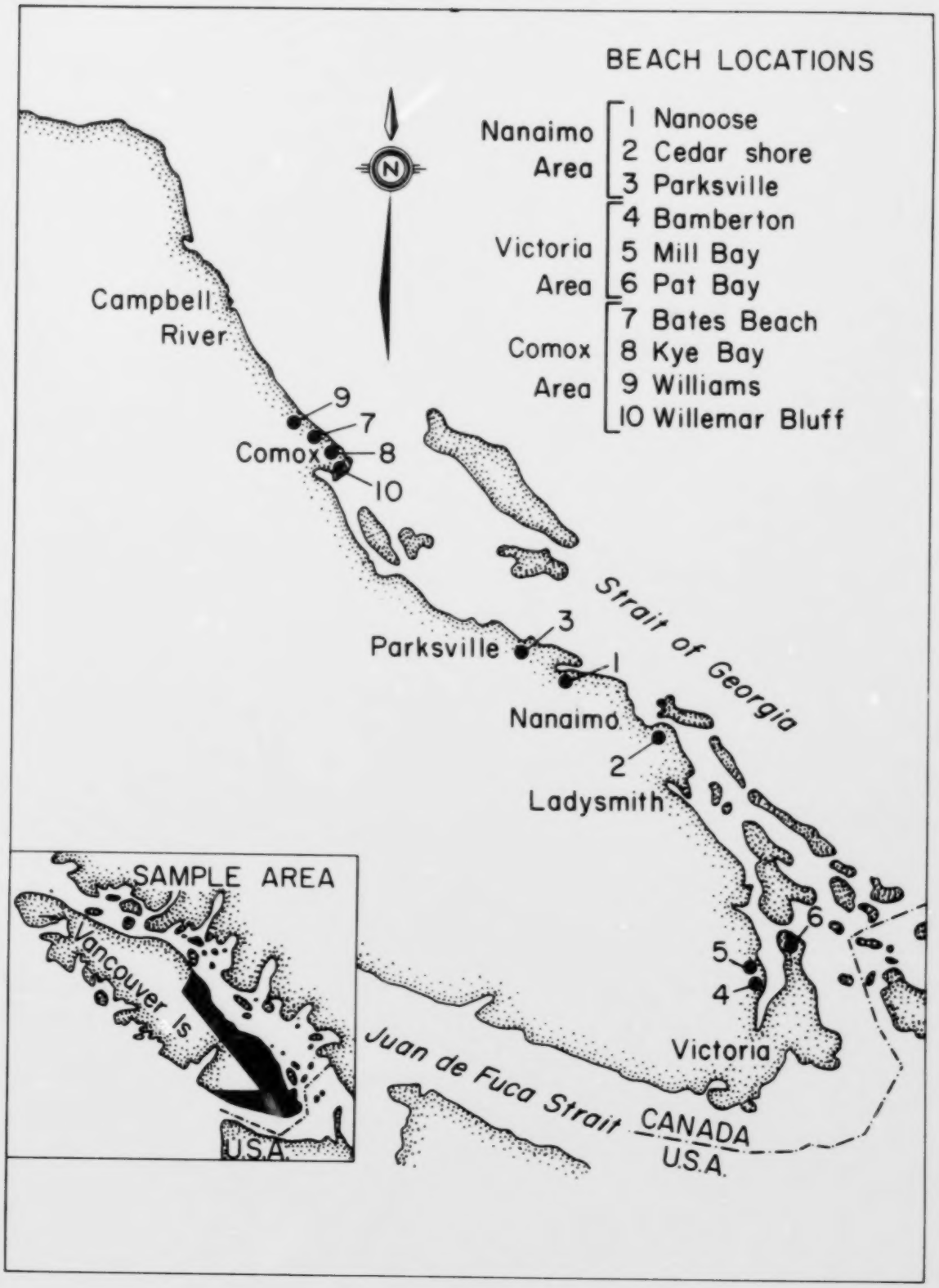
Table 14 (cont'd)

Beach location	Time	Number of clam diggers		
		Aircraft observers		
		Observer 1	Observer 2	Beach samplers
Kulleet Bay	1242	1 group (commercial)		
Coffin Island	1245	1 group (4 individuals)		
Cherry Point	1300	0		
Mill Bay	1303	4 groups (2,2,4,5 individuals)		3 groups (8 individuals)
Bamberton	1306	4 groups		
Pat Bay	1308	1 group		
Fulford Harbour	1313	0		
Clam Bay, Kuiper Island	1325	10 (commercial)		
Thetis Island	1328	0		

Table 15. Estimate of annual number of clams harvested per individual recreational clam digger. Values based on harvester's estimate and sampler estimate, actual mean number of clams per person times mean number of digs per year. Data recorded during the recreational clam harvest survey, August-September, 1984.

Area	Number of groups interviewed	Mean number clams per person	Mean number of clams per person per year, samplers estimate	Mean number clams per resident harvester per person per year, samplers estimate	Mean number of clams per non-resident harvester per person per year, samplers estimate	Number of clams per person per year, harvesters estimate
Nanoose	186	76	319	358	134	438
Nanaimo	17	55	299	395	113	214
Voctoria	51	91	455	398	144	368
Comox	11	75	563	-	-	452
Total	265	77	346	367	133	411

Fig. 1. Map of the southern part of the Strait of Georgia, British Columbia, showing the location of ten beaches where recreational clam diggers were interviewed in the recreational clam harvest survey, August-September, 1984.


BEACH LOCATIONS
Nanaimo Area
1 Nanoose
2 Cedar shore
3 Parksville
Victoria Area
4 Bamberton
5 Mill Bay
6 Pat Bay
Comox Area
7 Bates Beach
8 Kye Bay
9 Williams
10 Willemar Bluff
N
Campbell River
Comox
Parksville
Nanaimo
Ladysmith
Victoria
Strait of Georgia
Juan de Fuca Strait
CANADA
U.S.A.
SAMPLE AREA
Vancouver Is.
U.S.A.

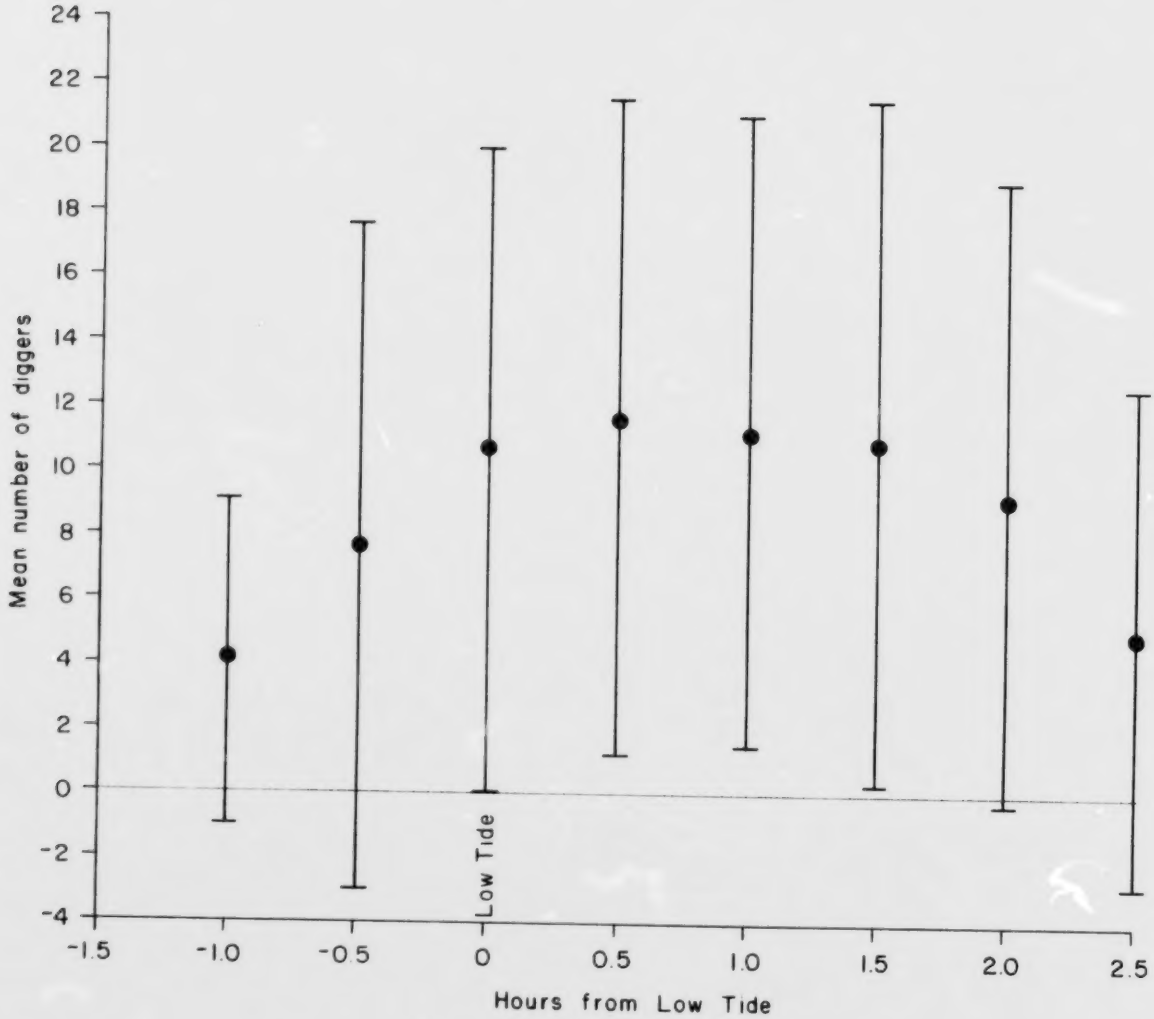


Fig. 2. Relationship between number of recreational clam diggers on beaches and state of the tide during the recreational clam harvest survey, August-September, 1984. Bars indicate standard deviation.

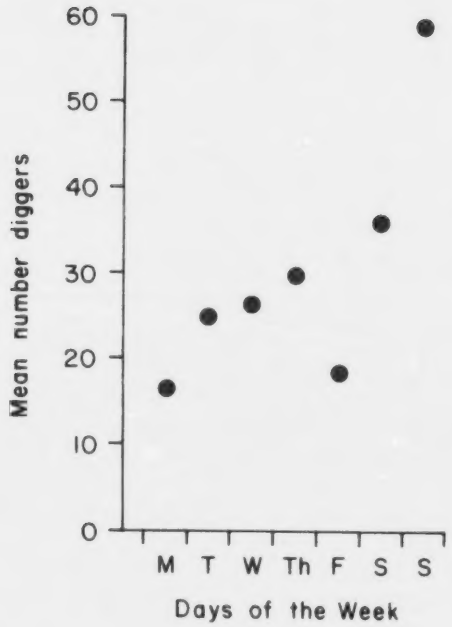


Fig. 3. Relationship between number of recreational clam diggers and days of the week as recorded in the recreational clam harvest survey, August-September, 1984.

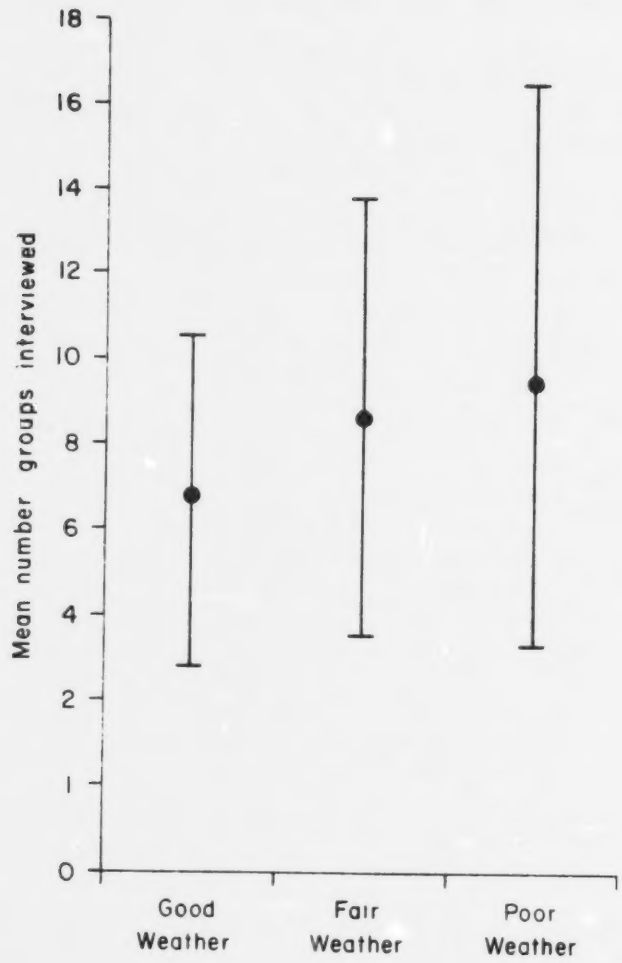


Fig. 4. Effect of weather on number of recreational clam diggers observed on beaches in the recreational clam harvest survey, August-September, 1984. Bars indicate standard deviation.

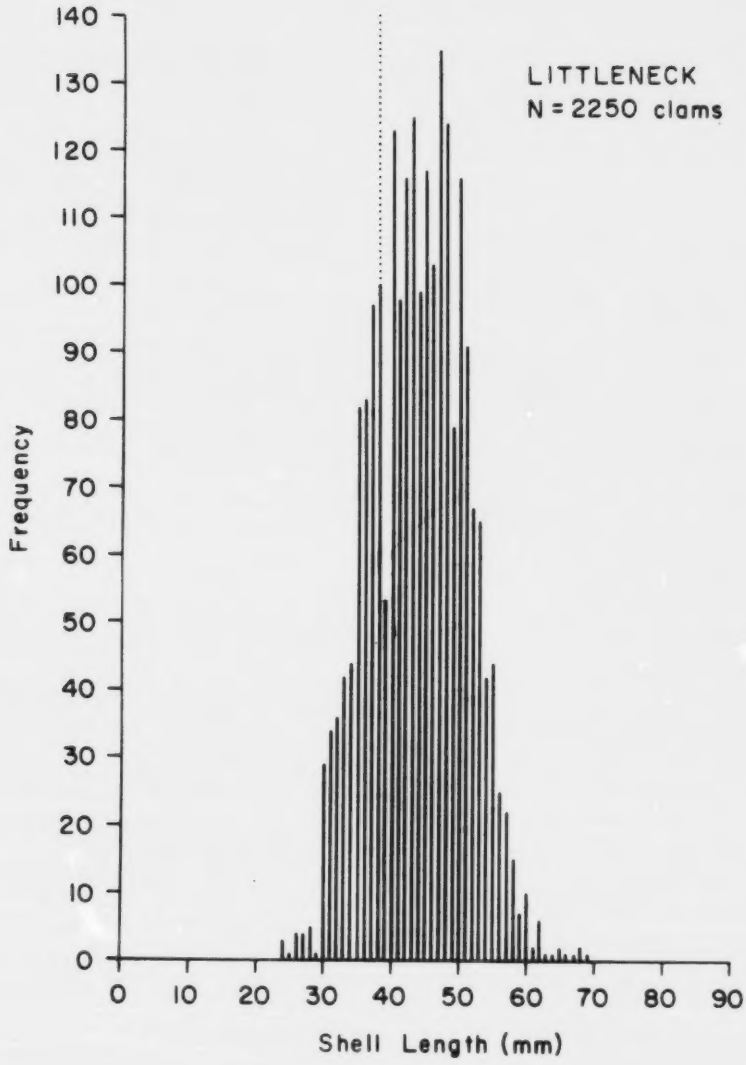


Fig. 5. Size frequency distribution of littleneck clams from all catches of recreational clam diggers sampled during the recreational clam harvest survey, August-September, 1984. Dotted line indicates legal size limit in the commercial fishery, 38 mm.

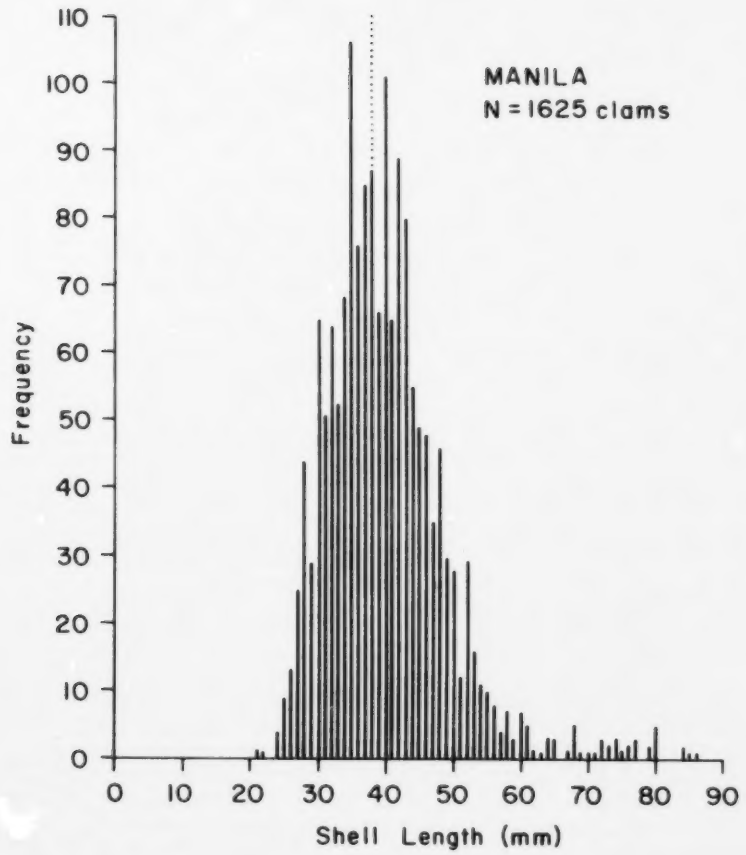


Fig. 6. Size frequency distribution of manila clams from all catches of recreational clam diggers sampled during the recreational clam harvest survey, August-September, 1984. Dotted line indicates legal size limit in the commercial fishery, 38 mm.

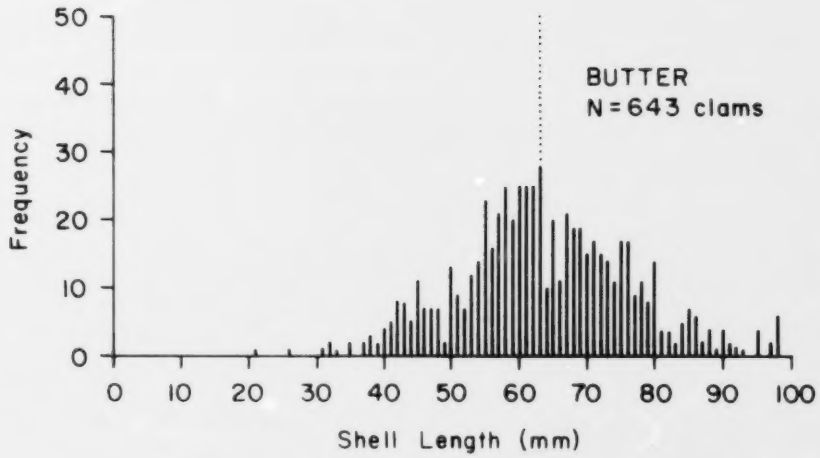
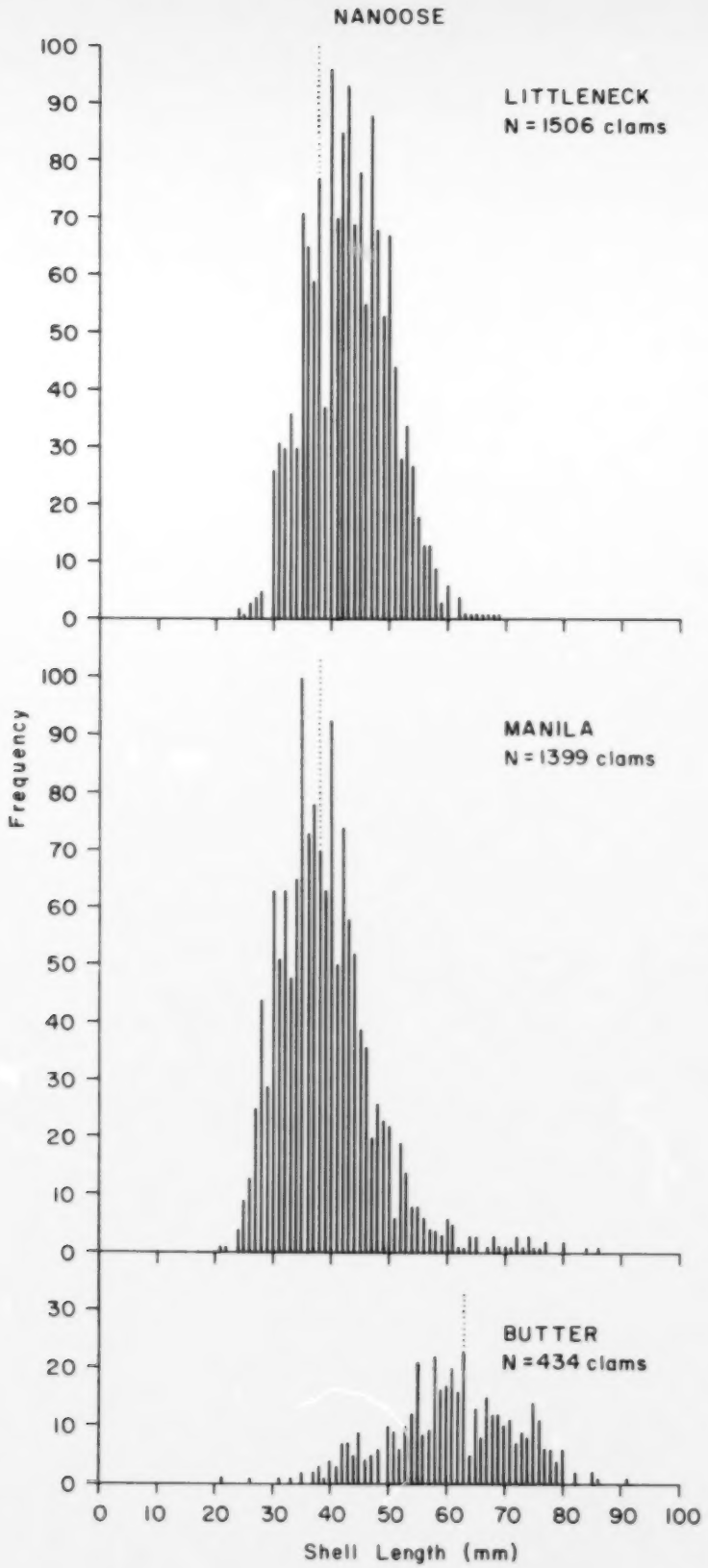


Fig. 7. Size frequency distribution of butter clams from all catches of recreational clam diggers sampled during the recreational clam harvest survey, August-September, 1984. Dotted line indicates legal size limit in the commercial fishery, 38 mm.


NANOOSE
LITTLENECK
N = 1506 clams
MANILA
N = 1399 clams
BUTTER
N = 434 clams
Frequency
Shell Length (mm)
0
10
20
30
40
50
60
70
80
90
100

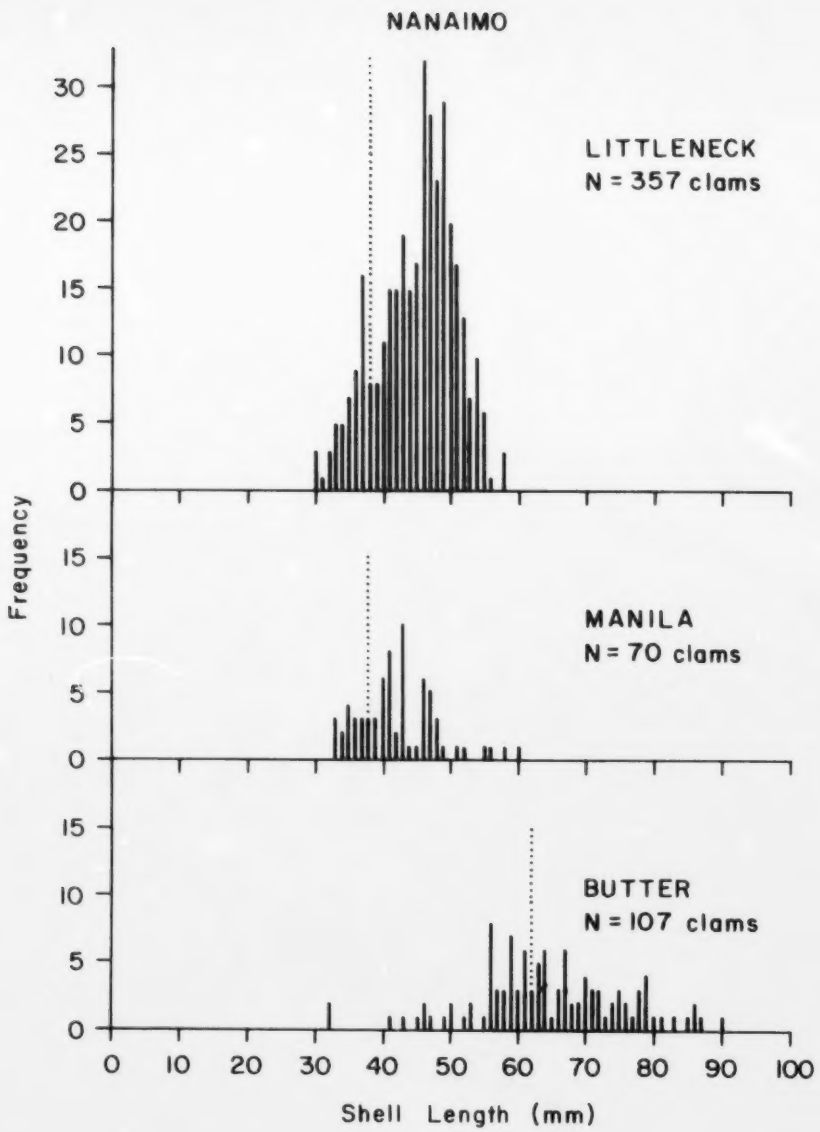


Fig. 9. Size frequency distribution of littleneck, manila, and butter clams from catches of recreational clam diggers on Nanaimo beaches, August-September, 1984. Dotted lines indicate size limit in the commercial fishery.

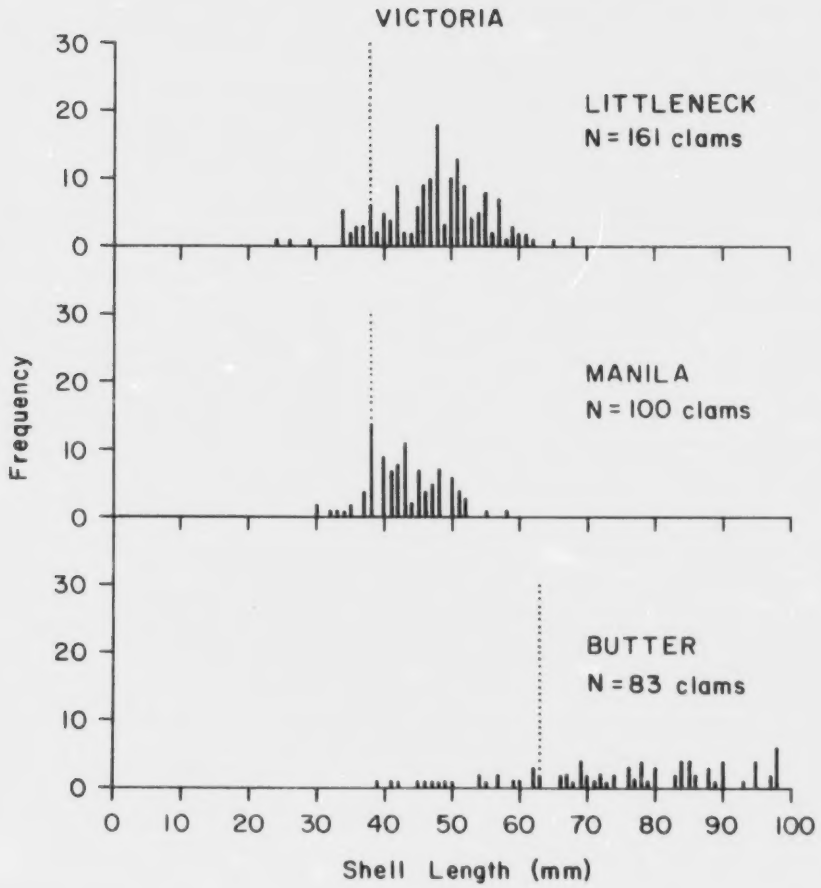


Fig. 10. Size frequency distribution of littleneck, manila, and butter clams from catches of recreational clam diggers on Victoria beaches, August-September, 1984. Dotted lines indicate size limit in the commercial fishery.

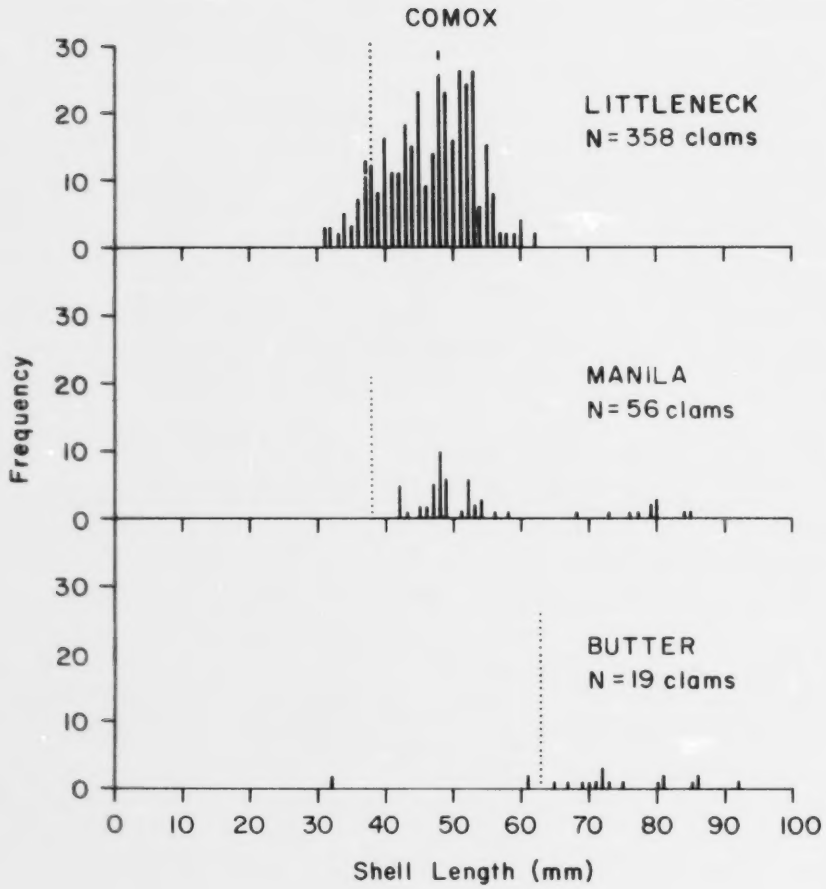


Fig. 11. Size frequency distribution of littleneck, manila, and butter clams from catches of recreational clam diggers on Comox beaches, August-September, 1984. Dotted lines indicate size limits in the commercial fishery.

Appendix 1. Original harvester's profile questionnaire used in the recreational clam harvest survey, August-September, 1984.

HARVESTER PROFILE

Are you a coastal resident?

How many times in a year do you go digging?

Do you only dig during daylight tides?

How many times do you usually dig in one tidal series?

What other areas do you dig in?

What species do you target on?

Does your target change with area, or season?

How many clams do you harvest in a year? Species or Kg.

Are you familiar with the regulations for recreational harvest?

Are you familiar with the PSP and sewage closures in the area, or the methods for inquiry?

Appendix 2. Revised harvester's profile questionnaire used in the recreational clam harvest survey, August-September, 1984.

HARVESTER PROFILE

Date. No. of diggers. Beach. Sample No.

Are you a local resident? If no, where?

How many times in a year do you go digging?

Do you ever dig on night tides?

In this week of low tides how many times will you dig clams?

What other areas do you dig in?

What species do you target on?

Does your target change with area, or season?

How many clams do you harvest in a year? Species or kg.

Samplers estimate of this catch.

Are you familiar with the regulations for recreational harvest?

Are you familiar with the PSP and sewage closures in the area, or the methods for inquiry?

Do you have a sport Salmon Licence?

Appendix 3. Proposed data sheet for recording temporal distribution of recreational clam diggers. Numbers allow for computer coding.

YEAR		MONTH		DAY		TIME OF LOW TIDE				+/-	TIDAL HEIGHT (m)		AREA		BEACH	
4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	21	22

HOURS (FROM LOW TIDE)

	-1.0	-0.5	LOWTIDE 0	0.5	1.0	1.5	2.0	2.5
# GROUPS	23	24	25	26	27	28	29	30
# RECREATIONAL DIGGERS	31	32	33	34	35	36	37	38
# COMMERCIAL/ NATIVE DIGGERS	39	40	41	42	43	44	45	46

Appendix 4. Proposed recreational clam harvester profile questionnaire that could be used in future recreational clam harvest surveys.

SAMPLE # (1 2 3) YEAR MONTH DAY (4 5 6 7 8 9) TIME of LOW TIDE (10 11 12 13) +/- TIDAL HEIGHT (m) (14 15 16) AREA BEACH (17 18 21 22)

HARVESTER PROFILE
198_ RECREATIONAL CLAM HARVEST SURVEY

SAMPLER _____

1.) Do you live within 80 km / 50 miles of this beach? (>50 miles is non-local) — LOCAL (23 24) NON-LOCAL (25 26)

2.) How many times in a year do you go digging? (first time digging = • •) — LOCAL (27 28) NON-LOCAL (29 30)

OF DIGGERS

3.) In this week of low tides, how many times will you dig clams? (40 41)

4) Do you ever dig on night tides? Y or N (42)

5.) What other areas do you dig in? (43 44)
a) no other b) Nanaimo c) Comox
d) Victoria e) b,c,d f) other areas

6.) Do you target on any species? (45 46 47)
a) Steamers b) Butters c) others - note

7.) How many clams do you harvest in a year? (48 49 50 51)

40 = local (L) or non-local (N) for questions 3 - 7

8.) Are you familiar with "red tide" and sewage closures in the areas, or the methods for enquiry? — YES (52 53) NO (54 56)

9.) Are you familiar with the regulations for recreational harvest? — YES (56 57) NO (58 59)

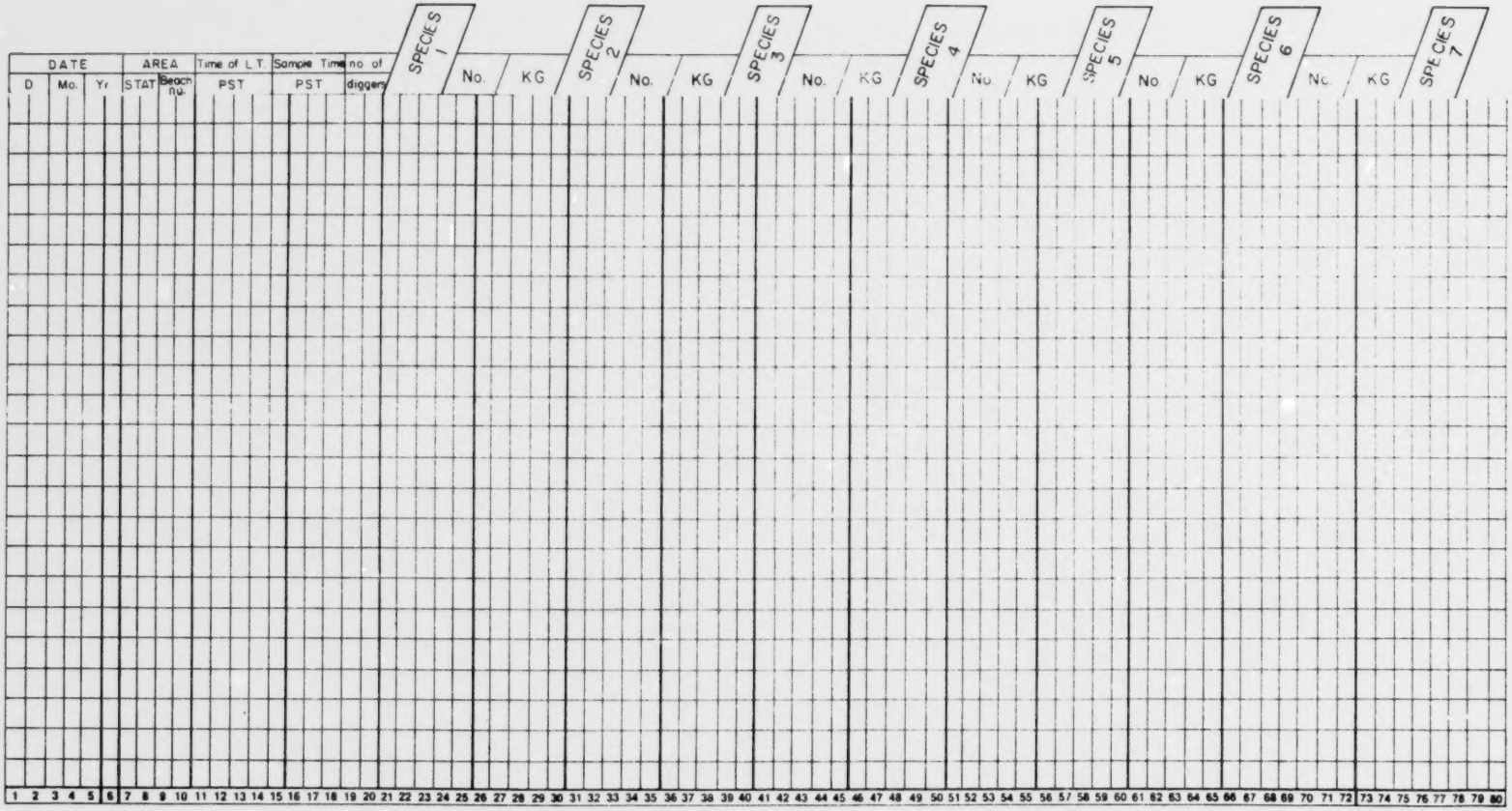
10.) Do you have a sport fishing licence? — YES (60 61) NO (63 64)

OF DIGGERS

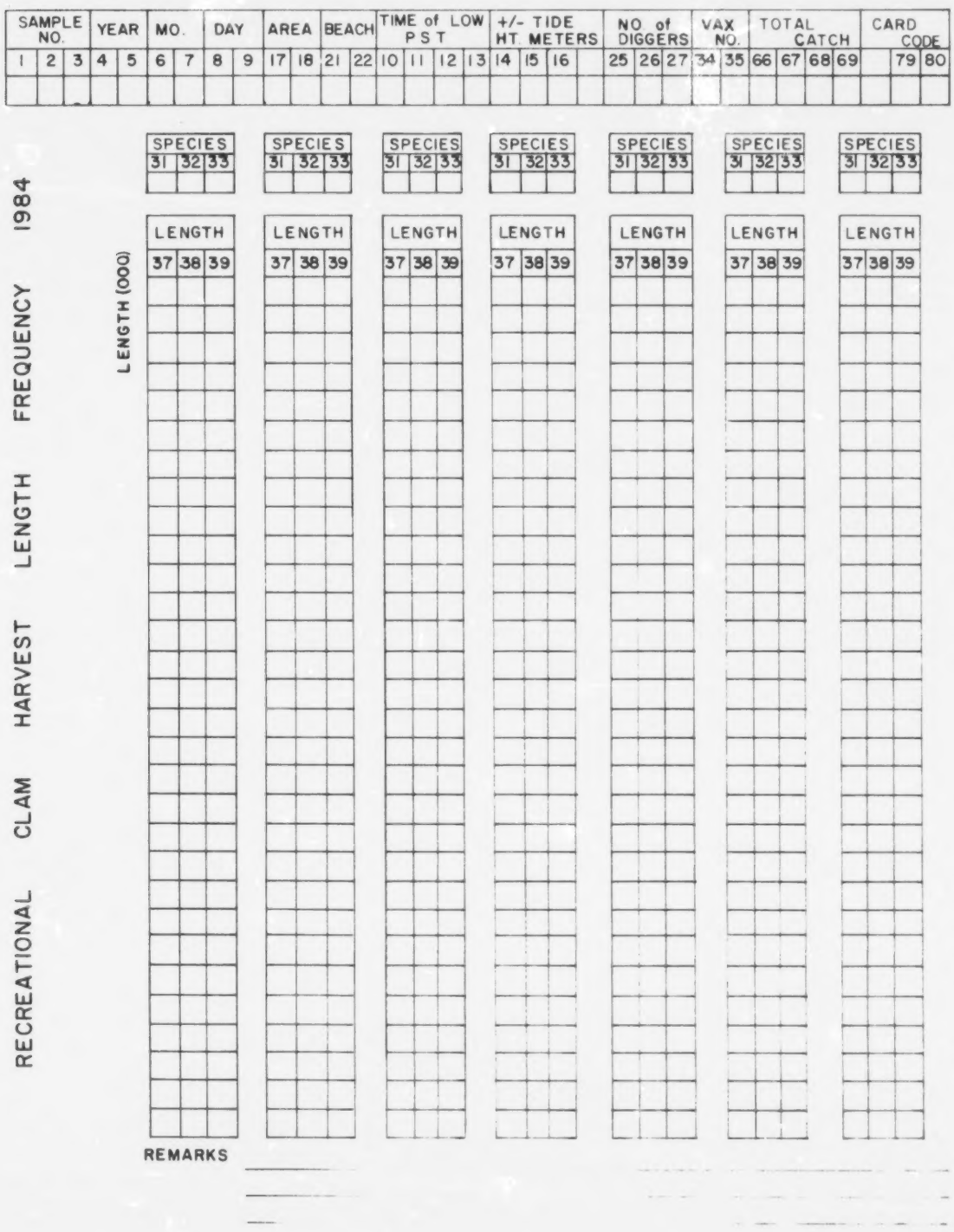
Samplers' estimate of this catch (By species if possible, or else total). TOTAL NO. (66 67 68 69)

Appendix 5. Harvest log sheet used in the recreational clam harvest survey, August-September, 1984.

RECREATIONAL HARVEST LOG CATCH



Appendix 6. Data sheet used to record clam length frequency data in the recreational clam harvest survey, August-September, 1984.


RECREATIONAL CLAM HARVEST LENGTH FREQUENCY 1984
SAMPLE NO. 1 2 3
YEAR 4 5
MO. 6 7
DAY 8 9
AREA 17 18
BEACH 21 22
TIME of LOW PST 10 11 12 13
+/- TIDE HT. METERS 14 15 16
NO of DIGGERS 25 26 27
VAX NO. 34 35
TOTAL CATCH 66 67 68 69
CARD CODE 79 80
SPECIES 31 32 33
LENGTH 37 38 39
LENGTH (OOQ)
REMARKS

Appendix 7. Proposed clam length frequency data sheet that could be used in future recreational clam harvest surveys.